

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

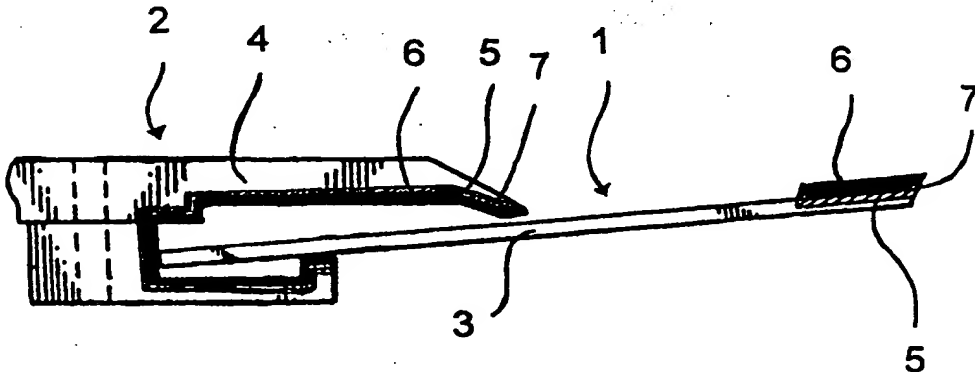
- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problems Mailbox.**

THIS PAGE BLANK (USPTO)

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : D21G 3/00	A1	(11) International Publication Number: WO 99/64674 (43) International Publication Date: 16 December 1999 (16.12.99)
(21) International Application Number: PCT/FI99/00459 (22) International Filing Date: 27 May 1999 (27.05.99) (30) Priority Data: 981312 9 June 1998 (09.06.98) FI (71) Applicant (for all designated States except US): VALMET CORPORATION [FI/FI]; Panuntie 6, FIN-00620 Helsinki (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): RATA, Ilkka [FI/FI]; Vitsiälänkatu 4, FIN-40520 Jyväskylä (FI). NIEMI, Kari [FI/FI]; Lennostontie 4 I 16, FIN-41160 Tikkakoski (FI). TOIVANEN, Heikki [FI/FI]; Pitkäläntie 16, FIN-40950 Muurame (FI). LINTULA, Timo [FI/FI]; Lintusyrjäntie 64, FIN-42700 Keuruu (FI). ESKELINEN, Ilkka [FI/FI]; Kipparinpolku 9, FIN-78300 Varkaus (FI). (74) Agent: FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).		(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> <i>In English translation (filed in Finnish).</i>
(54) Title: DOCTOR BLADE AND BLADE HOLDER COMPRISING COMPOSITE MATERIAL AND CERAMIC COATING		
		
(57) Abstract		
<p>The invention relates to an apparatus comprising a holder (2) for a doctor blade and a blade (1) to be fitted in the holder for use in a paper or board machine. The holder (2) and/or the blade (1) comprises a composite material of whose surface or on a part of whose surface a ceramic coating (6) has been made.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav	TM	Turkmenistan
BF	Burkina Faso	GR	Greece		Republic of Macedonia	TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

DOCTOR BLADE AND BLADE HOLDER COMPRISING COMPOSITE MATERIAL AND CERAMIC COATING

5

The invention relates to an apparatus comprising a holder for a doctor blade and a doctor blade to be fitted in the holder for use in a paper or board machine.

10

Doctors are used for removing impurities formed on the surface of rolls in paper, board and finishing machines. The doctor is composed of a doctor blade which comes into contact with the roll surface detaching impurities etc, and of a blade holder to which the blade is attached. The holder is in turn attached to a doctor beam arranged on the frame of the machine. In connection with doctoring, air, water and/or chemical jets can be used for enhancing the cleaning process.

15

20

The doctor blade is most commonly made of metal. Metal blades suffer from the drawbacks that the roll surface is being coated with doctor metal and the roll surfaces are easily damaged. It is undesirable that the roll surface is being coated with metal because a change in the surface properties of the roll has an unpredictable effect on runnability. For reasons of runnability, even slight damage to the roll surfaces, for example, scratching, is a serious drawback. Metal blades have great problems in doctoring polymeric roll surfaces in particular. In order to overcome these problems, metal blades have been coated with different materials, among other things, with a ceramic. As examples of coated metal blades may be mentioned *EP* 0 262 137, in which a doctor blade made of carbon steel is coated with molybdenum or a molybdenum alloy by flame spraying, and *SE 437 681*, in which a doctor blade made of steel is coated with several ceramic coating layers using a plasma or flame spraying method.

25

30

In recent years, in addition to metal blades, increasing use has been made of doctor blades manufactured of fibre-reinforced polymeric material. Such so-called composite blades are disclosed, for example, in *US patent 4,549,933* and in *FI*

patent applications 972776 and 973659. Composite blades have several advantages over metal blades, among other things, light weight, price, freedom of shaping, and gentleness to the roll coating. On the other hand, composite blades wear more quickly than metal blades and leave polymeric material on the roll surface. It has not
5 been possible to coat composite blades with a ceramic or with an equivalent more wear-resistant material because ceramic material does not adhere to a polymeric surface and, on the other hand, polymeric material does not withstand spray coating taking place at high temperature.

10 Conventionally, the holder of the doctor blade has also been manufactured of steel. Holders have also been made of plastic and of composite materials, but there have been problems in their abrasion resistance. Doctor blades are attached to holders by means of metal rivets or other equivalent members. The blades are replaced frequently, and the metal rivets rub against and wear the holder heavily. In particular,
15 the scratching of the inner surface presents a problem because the scratched surface makes it difficult to fit a new blade in place and, when carbon fibre blades are used, the risk of the blade being damaged because of the scratching of the holder is also obvious.

20 The object of the invention is to provide a doctor blade and a blade holder as well as an apparatus which are lighter in weight, more resistant to wear and more advantageous.

25 Characteristic features of the apparatus, doctor blade and blade holder according to the invention are stated in the claims.

It was found that the problems and disadvantages of prior-art arrangements can be avoided by the arrangement according to the invention in which the doctor blade and/or the blade holder is/are made of a composite material on which a ceramic
30 coating has been formed. A composite blade does not scratch the surface of the roll, in contrast to a blade which is coated, for instance, with a ceramic or carbide and whose coating has worn off exposing metal. The composite material may be a fibre-

reinforced thermosetting or thermoplastic resin. The ceramic coating can be formed and caused to hold on the composite structure such that the composite structure is provided with an anchor structure of a metal wire, wire mesh, metal foil, a metal powder or equivalent, which anchor structure enables the ceramic to be fixed to the surface of the composite or below the surface if the anchor structure is below the surface. The anchor structure may be on the surface of the composite, partly in the composite structure or totally embedded in the composite structure very close to the surface. The ceramic coating is formed onto the surface of the composite by means of thermal spraying at a temperature that is below 150 °C, at which the composite does not substantially melt nor is otherwise damaged. There are no limitations on the shaping of the blades or blade holders made of a composite material. The doctor blade and the holder in accordance with the invention can be manufactured of a thermosetting or thermoplastic resin reinforced with fibreglass or carbon fibre, with boron fibre and generally with a fibre composite or their combination. Carbon fibre is particularly preferable since its thermal conductivity is very close to the thermal conductivity of metals. A metal wire, a metal strip, wire mesh, metal foil, a metal powder, combinations of metal and plastic, or a plastic-ceramic powder is/are fixed to the surface of the composite or embedded in the composite. Suitable methods of manufacturing composite blades and holders are casting, compression moulding, pultrusion and extrusion methods and combinations of different methods. The selection of the method is also affected by the orientation of desired fibre directions. The pultrusion method is the most preferable method for its good production rate. On the doctor blade or the blade holder made of a composite material, a ceramic coating is made by means of thermal spraying or by means of electrolytic methods, such as brush electroplating, or by means of autocatalytic methods, such as chemical nickel plating, where ceramic is in dispersion. All conventional ceramics are suitable ceramic materials. However, preferable materials are those which can be readily sprayed, which are low-priced and chemically durable, such as Al_2O_3 and Cr_2O_3 . The doctor blade may be provided with a ceramic coating either over the entire surface area or only over the wear area depending on where the blade is used. Preferably, one third of the width of the blade is coated. The coating of the doctor blade or the blade holder can be performed with the same ceramic or with a combi-

nation of different ceramics, and one or more ceramic layers can be made one above the other. If the composite sections are not completely coated with a ceramic coating, possible wetting of the composite material may be prevented by providing a protective coating on the surface of the composite, for example, electrolytically.

- 5 The apparatus according to the invention comprising a doctor blade and a holder for the doctor blade can be used in paper and board machine lines, which also include printing machines and coating machines. Optionally, only either the blade or the holder is made of a composite material coated with a ceramic and the other of them is made of metal or another suitable material.

10

In the following, the invention is illustrated by way of example by means of one advantageous embodiment of the invention, to the details of which the invention is, however, not intended to be confined.

- 15 Fig. 1 is a schematic view of a doctor blade and a holder for the doctor blade. The doctor blade 1 is fitted in the doctor blade holder 2. A core part 3 of the doctor blade 1 comprises a composite material whose surface layer is provided with an anchor layer 5 on which a ceramic layer 6 has been made. A core part 4 of the blade holder 2 comprises a composite material to whose surface layer an anchor layer 5 is fixed, a ceramic layer 6 being formed on said anchor layer. Before preparing the ceramic coating, different intermediate layers 7 may be used for equalizing the heat generated in the spraying of ceramic and for reducing the risk of the composite being damaged. The intermediate layers may be of metal, for example, aluminium- and nickel-based materials, advantageously of a sprayed metal. In this arrangement, the blade is coated only in the wear area and the holder on its inside which comes into contact with the blade. The blade is preferably coated at its front side, so that sharpening of the blade and its keeping sharp are accomplished in the best way.
- 20
- 25

- The advantages of the doctor blade and the blade holder in accordance with the invention include good chemical durability of the apparatus, the composite blade can be readily mounted in the holder and treatment is easy. Both the blade and the holder are light in weight and they are easy to machine. Both withstand wear and
- 30

scratching well and thus their service life is longer than that of previous arrangements. The doctor blade holder manufactured of a composite is very light in weight. With increasing machine speeds, even in difficult locations, because of lack of space, it has been necessary to apply supercritical dimensions in connection with doctor beams of prior art arrangements, which causes that the doctor beam is less rigid. Because of the smaller rigidity of the beam, it is beneficial to reduce the weight of the holder because the reduction of the weight of the holder contributes to decreasing the deflection of the beam. The price of the blade holder made of a composite material is competitive since the manufacturing costs of the holder are lower and, on the other hand, the operating costs of the blades are lower for the reason that the blades need not be replaced so frequently. Further, these blades wear rolls to a considerably smaller extent because they do not scratch the surface. With respect to dimensions, the apparatus has a greater rigidity and a low weight with the result that less loading energy is needed, excluding the load based on gravity. The low weight of the holder facilitates mounting and displacement.

Claims

1. An apparatus comprising a holder (2) for a doctor blade and a blade (1) to be fitted in the holder, characterized in that the holder (2) and/or the blade (1) comprises a composite material, on whose surface or on a part of whose surface a ceramic coating (6) has been made.
2. An apparatus as claimed in claim 1, characterized in that the composite material comprises a fibre-reinforced thermosetting or thermoplastic resin, preferably a thermosetting or thermoplastic resin reinforced with carbon fibre, fibre glass or boron fibre.
3. An apparatus as claimed in claim 1 or 2, characterized in that an anchor structure (5) is embedded in the composite material or fixed to the surface of the composite material, which anchor structure may be made of a metal wire, wire mesh, a metal strip, metal foil, a metal powder, combinations of metal and plastic, a plastic-ceramic powder, a ceramic powder or a combination of these in order to fix the ceramic coating (6) and/or an intermediate layer (7).
4. An apparatus as claimed in any one of claims 1 to 3, characterized in that the ceramic coating (6) comprises Al_2O_3 , Cr_2O_3 , TiO_2 , ZrO_2 or combinations of them, and the intermediate layer (7) comprises a metal, preferably an Al- or Ni-based metal.
5. A doctor blade (1), characterized in that the blade (1) comprises a composite material on whose surface or on a part of whose surface a ceramic coating (6) has been made.
6. A doctor blade (1) as claimed in claim 5, characterized in that the composite material comprises a fibre-reinforced thermosetting or thermoplastic resin, preferably a thermosetting or thermoplastic resin reinforced with carbon fibre, fibre glass or boron fibre.

7. A doctor blade (1) as claimed in claim 5 or 6, characterized in that an anchor structure (5) is embedded in the composite material or fixed to the surface of the composite material, which anchor structure may be made of a metal wire, a metal strip, wire mesh, metal foil, a metal powder, combinations of metal and plastic, a plastic-ceramic powder, a ceramic powder or a combination of these in order to fix the ceramic coating (6) and/or an intermediate layer (7).
8. A doctor blade (1) as claimed in any one of claims 5 to 7, characterized in that the ceramic material comprises Al_2O_3 , Cr_2O_3 , TiO_2 , ZrO_2 or combinations of them, and the intermediate layer (7) comprises a metal, preferably an Al- or Ni-based metal.
9. A blade holder (2), characterized in that the holder (2) comprises a composite material, on whose surface, partly or wholly, a ceramic coating (6) has been made.
10. A holder (2) as claimed in claim 9, characterized in that the composite material comprises a fibre-reinforced thermosetting or thermoplastic resin, preferably a thermosetting or thermoplastic resin reinforced with carbon fibre, fibre glass or boron fibre.
11. A holder (2) as claimed in claim 9 or 10, characterized in that the holder (2) comprises a composite material on whose surface or on a part of whose surface a ceramic coating (6) has been made.
12. A holder (2) as claimed in any one of claims 9 to 11, characterized in that the ceramic coating (6) comprises Al_2O_3 , Cr_2O_3 , TiO_2 , ZrO_2 or combinations of them, and an intermediate layer (7) comprises a metal, preferably an Al- or Ni-based metal.
13. A holder (2) as claimed in any one of claims 9 to 12, characterized in that the inside of the holder (2) is coated with a ceramic.

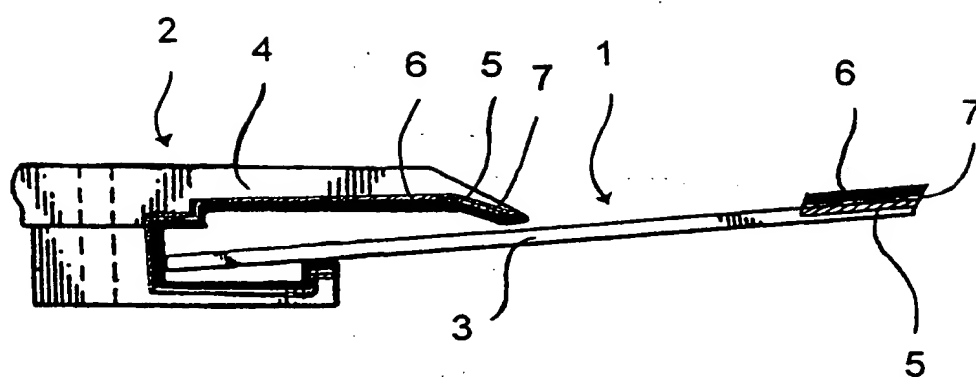


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 99/00459

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21G 3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D21G, B41F, B05C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC, WPI, FULLTEXT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5727468 A (JOSEPH GORDON BLACKWELL), 17 March 1998 (17.03.98), column 4, line 24 - line 34 --	1-13
Y	JP 5338048 A (TEIJIN LTD) 1993-12-21(abstract) World Patents Index (online). London, U.K.: Derwent Publications, Ltd. (retrieved on 1999-10-06). Retrieved from: EPO WPI Database. DW 199404, Accession No. 1994-031397; & JP 5338048 (TEIJIN LTD) 1994-03-24 (abstract) (online)(retrieved on 1999-10-06). Retrieved from: EPO PAJ Database --	1-13
A	US 5408720 A (ALAN A. MILES), 25 April 1995 (25.04.95) --	1-4,9-13

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

6 October 1999

Date of mailing of the international search report

08-10-1999

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Helena Hemphälä/ELY
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 99/00459

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 54149787 (ICHIKAWA KEORI KK) 1979-11-24 (abstract) World Patents Index (online). London, U.K.: Derwent Publications, Ltd. (retrieved on 1999-10-06). Retrieved from: EPO WPI Database. DW 198002, Accession No. 1980-02479C	1-13
A	JP 4070341 (DAINIPPON PRINTING CO LTD) 1992-03-05 (abstract). (online) (retrieved on 1999-10-06). Retrieved from: EPO PAJ Database	1-13

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/08/99

International application No.

PCT/FI 99/00459

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5727468 A	17/03/98	DE 29605378 U FR 2733720 A,B	21/11/96 08/11/96
US 5408720 A	25/04/95	EP 0589017 A FI 935520 A GB 2265917 A JP 6509402 T WO 9321380 A	30/03/94 09/12/93 13/10/93 20/10/94 28/10/93

THIS PAGE BLANK (USPTO)